

Mechanism for Detection of Subtle Luminosity Fluctuations Associated with Acoustic Energy in Atmosphere Under Condition of Full Brightness

2 June 2025

Simon Edwards

Research Acceleration Initiative

Introduction

Prior publications by this author (ibid.) open up the possibility of both the intercept of verbal communications from space-based platforms through optical analysis as well as rendering trivial the detection of so-called low-observable aircraft flying at any altitude, provided that the mode of propulsion of those aircraft is noise-generating.

Although mechanisms already exist which allow for the detection of extremely faint signals as weak as a single photon under laboratory conditions, when taking photographs opto-electronically under conditions of full brightness (required for this application,) there are limitations on the level of contrast which are possible using current methods. For this application, we should wish to detect subtle differences in the level of absolute brightness under conditions of full daylight as viewed from a space-based platform.

A metaphor one could use to explain this problem would be a magician on stage asking someone to count the number of marbles tossed from his hand while they are in mid-air. If the number of marbles is, say, four or five, it might be possible for someone with a sharp eye to count them. However, if he threw hundreds, thousands, or millions of marbles, it would be very hard for anyone to accurately count them. The following proposal explores the idea of getting to the right answer by having the magician throw just a few marbles at a time over many iterations so that we might get an accurate count of the overall number thrown in a series which ultimate adds up to millions.

Abstract

Using a novel approach, it is possible to overcome this limitation, which stands in the way of the recently proposed concept for the remote measurement of acoustic energy via optical flicker detection.

A two-layer meta-material which is either optically reflective or optically transparent depending upon whether it is electrified may be used in conjunction with alternating application of voltage in the terahertz regime in order to cause incoming ambient light to be reflected back in the direction of the light source. When light is reflected, it results in phase cancellation inasmuch as frequency, amplitude, phase and angular momentum are congruous. Although such congruity does not necessarily occur each and every time light is retro-reflected, given the right system of control, phase-cancellation could be made to reliably occur, thereby serving as a means of physically subtracting (through physical elimination) the amplitude of the first wave from a subsequent wave, leaving only a few scattered photons associated with whatever the difference may be. This would enable us to determine the magnitude of the difference in amplitude of two waves of light

even whereas the difference is extremely subtle as these photons could be detected by an exquisitely sensitive photon detector optimized for extreme-low-light conditions in order to assess the difference in the amplitude of two waves of light from one wave to the next. By measuring these subtle differences over a period of hundreds of millions of waves ($\sim 1/200^{\text{th}}$ second i.e. the time it takes for a sound wave associated with the human voice to oscillate) the change over time could be assessed.

In order to ensure that only intended, amplitude-diminished light interacts with our exquisitely sensitive detector, a special filter must be used which permits only a single frequency of light to be admitted through an individual shutter composed of the aforementioned meta-material. The overall mechanism would consist of not one, but many shutters each of which have a different timing depending upon the permitted frequency. The speed of alternation of the properties of the meta-material must be timed to match the particular frequency permitted by the filter system in each specific area. Because the light from a single frequency would be insufficient to derive sufficient data for an acoustic reading, a range of frequencies must be permitted by a separate set of filters (or, more likely, by a graduated filter layer wherein the properties are the same at no two spatial points,) each of which terminate at a different sub-sensor the discrete “shutter” for which is specifically calibrated that phase-cancellations may be induced as intended and the amplitude differential may be computed through the sensitive photon detector.

As for this application, we do not care about the contents of an image, the absolute brightness or the color information but rather only care about extremely subtle differences between the brightness of successive waves of light sharing a common point of origin and angular momentum, such a detector would be ideal for use as a Passive Optical Microphone (POM, first described 11 May 2025.)

The correct structure for such a mechanism would be a series of N-shaped elongated crystals in which the interior portions of each interlocking two-layer meta-material are anionized unless electrified and in which this portion is, naturally, conductive whereas the exterior portions of the material are neutrally charged and are not conductive to electricity whilst also being optically transparent. Electrification of the space between the two layers bestows the interior nodes of the crystalline molecules with electrons which form a barrier and render the material reflective. The instant that current is suspended, the material returns to its optically transparent state.

Conclusion

Although structurally exquisite and finely calibrated, this mechanism is compact, solid-state and does not rely upon noise-prone CMOS sensors which are incapable of providing the needed contrast. Although R&D costs would likely be moderate, construction cost per unit would likely be low for such a system, which could be incorporated into other multi-purpose platforms as a module.